Background Calibration Sources for the SNO Experiment

X.Chen, Y.D.Chan, K.T. Lesko, C.E. Okada, A.W.P. Poon, R.G. Stokstad, A.D. Marino, and E.B. Norman

Understanding the background is one of the most important and also most difficult problems for any neutrino experiment simply because neutrino events are very rare. Natural radioactive decays are the major backgrounds in the SNO detector. Great efforts have been made to minimize and understand these backgrounds and calibration sources are essential to verify our understandings of these backgrounds.

One such source is being designed and constructed by the collaboration between the LBNL and the LANL SNO groups. This source has an outer acrylic capsule inside which a small amount of U or Th is encapsulated. By deploying this source to different positions of the detector, we can:

- Calibrate the Nhits spectra of major backgrounds in SNO. The radioactive background level determines the neutrino analysis threshold.
- Calibrate the hit patterns of various types of backgrounds which is the foundation of the *in situ* background monitoring technique.
- Calibrate the probability of deuteron photodisintegration by radioactive decays.
- Study systematics of the vertex fitters on the background events, which is crucial for determining the fiducial cuts on data.

We have carried out extensive Monte Carlo simulations in order to optimize the design of this source. Figure 1 shows the Nhits spectra of various decays in the source compared with spectra of decays in the heavy water.

Several prototypes of the sources have been constructed. They will be deployed in the near future. Because MC simulations show that refraction of photons at the acrylic-heavy water boundary reduces its capability to calibrate the hit patterns of background events, we are designing second generation of background calibration sources that could be made of materials with refraction indices close to that of water.

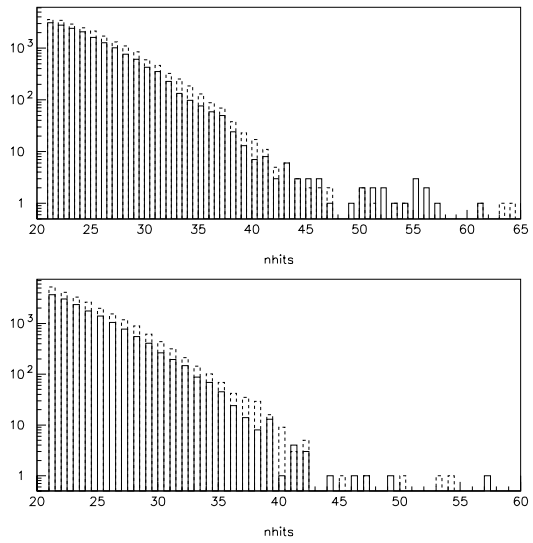

Figure 1: Nhits distribution of ^{208}Tl (upper plot) and ^{214}Bi (bottom plot) decays in the heavy water (solid line) and the acrylic source (dashed line).